Obesity Research & Clinical Practice (2017) 11, 158—166

# Associations between behavioural risk factors and overweight and obesity among adults in population-based samples from 31 countries

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Received 28 February 2016; received in revised form 15 July 2016; accepted 1 August 2016

**KEYWORDS**
Overweight;
Smoking;
Alcohol use;
Fruits and vegetable consumption;
Physical activity

**Summary**
*Objective:* Concern about overweight and obesity is growing worldwide, and more research to examine behaviours associated with the risk for increased weight in adult populations is needed. The aim of this study was to estimate associations between behavioural risk factors and overweight and obesity among adults in nationally representative population samples from 20 countries in Europe, 8 countries in Asia, Australia, Chile and USA.
*Methods:* This secondary analysis is based on the International Social Survey Program (ISSP), 2011—2013, Health and Health Care Module. In a cross-sectional population-based survey (N = 48,741) (mean age 46.6 years, SD = 17.4, age range 15—102 years) simple or multi-stage stratified random sampling was used, yielding representative samples of the adult population of respective countries. Body Mass Index was assessed by self-reported height and weight. Correlates were risk behaviours for chronic disease (smoking status, alcohol intake, consumption of fruits and vegetable (=FV), and physical activity).
*Results:* Overall, for all 31 countries the prevalence of overweight or obesity was 44.1%, 31.7% overweight and 12.4% obese. In adjusted logistic regression models, among men and among women ex-smoking was positively associated with both overweight and obesity, while light or moderate smoking overall and among men were

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http://dx.doi.org/10.1016/j.orcp.2016.08.001

inversely related with obesity. Moderate alcohol use was positively associated with both overweight and obesity, while heavy alcohol use was negatively associated with overweight. The daily consumption of FV was found to be protective from both overweight and obesity, overall and for men but not for women. Physical activity was positively associated with overweight but not obesity.
*Conclusions:* Some risk behaviours for chronic disease appear to be associated with overweight and obesity among adults. Interventions targeting these risk behaviours may have the potential to reduce weight.


## Introduction

Overweight and obesity were estimated to cause 3.4 million deaths in 2010 [1]. Globally, the proportion of adults with overweight or obesity (≥body-mass index (BMI) of 25 kg/m$^2$) increased to 36.9% in men and 38.0% in women in 2013 [1]. Obesity is a complex and multifactorial chronic disease originating from a genetic and environmental or behavioural interchange, caused by an imbalance between energy intake and expenditure [2]. The increasing obesity epidemic is accompanied by profound societal, demographic and cultural changes involving both dietary behaviour patterns and physical activity levels [2]. Apart from physical inactivity and inadequate food consumption, the determinants of other major behavioural factors such as alcohol use and smoking seem not so clear.

Regarding physical inactivity, Van Dyck et al. [3] found a curvilinear relationship of accelerometer-based moderate-to-vigorous physical activity and total counts per minute with BMI and the probability of being overweight/obese. The associations were negative, but weakened at higher levels of moderate-to-vigorous PA (>50 min per day) and higher counts per minute [3]. In terms of food consumption, especially regarding fruits and vegetable (FV) consumption, experimental studies found increased FV consumption (in conjunction with other behaviours) contributed to reduced adiposity among overweight or obese adults [4]. Longitudinal studies among overweight adults found greater F and/or V consumption was associated with slower weight gain [4]. An inverse relationship between FV intake and adiposity among overweight adults, however, appears weak [4]. A more recent systematic review of prospective cohort studies found that ''higher intake of fruits was inversely associated with weight change (decrease) and no significant changes could be observed for combined FV consumption or vegetable consumption'' [5]. However, comparing the highest combined FV, fruit, and vegetable intake categories, a 9%, 17%, and 17% reduced risk of adiposity, respectively, were found [5].

Regarding smoking, Rupprecht et al. [6,p. 289] note that there is an ''inverse relationship between BMI and smoking. Smokers with higher BMI consume more cigarettes per day and may be more nicotine-dependent than lean smokers.'' [7,8]. In relation to alcohol use, overall results do not conclusively confirm a positive association between alcohol consumption and weight gain; however, positive findings between alcohol intake and weight gain have mainly been reported from studies on higher levels of drinking [9]. Moreover, light-to-moderate alcohol intake, especially wine intake, may be more likely to protect against weight gain, whereas consumption of spirits has been positively associated with weight gain [9,10].

Studies investigating several common behavioural risk factors for overweight or obesity in specific countries seem to produce diverse results. For example, in Brazil among men, meat consumption showed a positive association with BMI, while physical activity was inversely associated with BMI, and among women, positively associated factors were no smoking and no meat consumption [11]. In China, among men, current smokers had a lower risk of overweight and obesity than non-smokers, and current male drinkers had a higher risk of overweight and obesity than non-drinkers [12]. In Finland, leisure-time physical activity, and daily vegetable consumption were inversely associated with obesity [13]. Obesity was also associated with alcohol consumption and smoking history [13]. In Portugal, smoking status was negatively associated with overweight and obesity [14]. Men with low physical activity level were more likely to be obese and alcohol consumption among women was associated with overweight and obesity [14]. In Turkey, obesity was associated positively with cessation of cigarette

smoking, alcohol consumption, and inversely with cigarette use, and physical activity [15]. In USA, among older adults, men who were occasional, light, or moderate drinkers were more likely to be obese than men who were non-drinkers [16]; women who were heavy drinkers were less likely to be obese than women who were non-drinkers [16]. Compared with men and women who were regularly active during leisure time, inactive men were more likely to be obese, and inactive women were more likely to be obese [16].

Various other confounding factors associated with overweight or obesity may include low socioeconomic status, urban or rural residence, poor mental health and activity limitations [14,16–18].

The aim of this study was to estimate associations between behavioural risk factors and overweight and obesity among adults in nationally representative population samples from 20 countries in Europe, 8 countries in Asia, Australia, Chile and USA.

## Method

### Data

This secondary analysis is based on the International Social Survey Program (ISSP), 2011–2013, Health and Health Care Module [19]. The Health and Health Care Module provides data for individuals' evaluation of the health care system, individuals' health status and health insurance coverage [19]. Information from respondents from 20 countries in Europe, 8 countries in Asia, Australia, Chile and USA was included in this analysis.

### Sampling and procedure

Sampling procedures differed for the individual countries either simple or multi-stage stratified random sampling, yielding representative samples of the adult population of respective countries [19]. Samples were designed to be representative of the adult population in each study country [19]. The cross-sectional survey included persons age 18 years and older, and in some countries 15 years (Finland) and 16 years (Italy, Japan) and older [19]. The mode of interview differed for the individual countries: partly face-to-face interviews (partly CAPI) with standardised questionnaire, partly paper and pencil and postal survey and partly web survey [19]. The ISSP questionnaire was developed and pretested by international teams and discussed and approved by the ISSP General Assembly (GA), which is the main representative body of the ISSP [20].

### Measure

*Body Mass Index (BMI)* was assessed by self-reported height and weight. BMI was classified as underweight <18.5 kg/m$^2$, normal weight 18.50–24.99 kg/m$^2$, overweight 25.0–29.99 kg/m$^2$, and obesity ≥30.00 kg/m$^2$ [21].

*Cigarette smoking* was assessed with the question, ''Do you smoke cigarettes, and if so about how many cigarettes a day?'' Response options were 1 = ''Do not smoke and never did'', 2 = ''Do not smoke now, but smoked in the past'', 3 = ''Smoke 1–5 cigarettes per day, 4 = ''Smoke 6–10 ...'', 5 = ''Smoke 11–20 ...'', 6 = ''Smoke 21–40...'', 7 = ''Smoke more than 40 cigarettes per day'' [19].

*Alcohol use* was assessed with the question, ''Drink 4 or more alcoholic drinks on the same day.'' Response options were 1 = never, 2 = once a month or less often, 3 = several times a month, 4 = several times a week, 5 = daily.

*Diet* was assessed with the question, ''Eat fresh fruit or vegetables.'' Response options were 1 = never, 2 = once a month or less often, 3 = several times a month, 4 = several times a week, 5 = daily.

*Physical activity* was assessed with the question, ''Do physical activity for at least 20 min that makes you sweat or breath more heavily than usual.'' Response options were 1 = never, 2 = once a month or less often, 3 = several times a month, 4 = several times a week, 5 = daily.

*Demography*: Sex, age, education, a subjective socioeconomic status question (top-bottom placement, from 1–10), place of living: urban–rural [19]. *Self-rated overall health (SRH)* was measured with the question: ''In general, Would you say your health is... Excellent (4), very good (3), good (2), fair (1), or poor (0)?'' [19].

*Psychological health* was assessed with the question, 'How often in the past four weeks did you feel unhappy and depressed.' Response options were never (0), seldom (1), sometimes (2), often (3), and very often (4) [19].

*Chronic condition or disability*, ''Do you have a long-standing illness, a chronic condition, or a disability?'' (Yes, No) [19].

*Activity limitations* were assessed with the question, ''During the past 4 weeks, to what extent did your health problems limit your usual social activities with family or friends?'' Response options ranged from 1 = never to 5 = very often [19].

### Data analysis

Data analysis was conducted using STATA software version 13.0 (Stata Corporation, College Station, Texas, USA). Descriptive statistics were used to

calculate frequencies, percentages and means. Using a sampling weight, weighted percentages and confidence intervals are reported. Multivariate logistic regression analysis, Multivariate logistic regression, adjusted for age, sex, education, subjective economic status, residential status, psychological well-being, chronic condition and activity limitation, was used to identify associations between behavioural risk factors and overweight and obesity. The P-value of less than 5% is used to indicate statistical significance.

## Results

### Sample characteristics

The total sample included 48,741 adults (with complete data on BMI) (mean age 46.6 years, SD = 17.4, age range 15—102 years) from 31 countries (Australia, Belgium, Bulgaria, Chile, China, Germany, Taiwan, Croatia, Czech Republic, Denmark, Finland, France, Israel, Italy, Japan, South Korea, Lithuania, Netherlands, Norway, Philippines, Poland, Portugal, Russia, Slovakia, Slovania, Spain, Sweden, Switzerland, Turkey, United States, United Kingdom) ranging from 805 in the UK to 5397 in China. Response rates ranged from 31.2% in Australia to 73.9% in Japan [17]. Overall, for all 31 countries the prevalence of overweight or obesity was 44.1%, 31.7% overweight and 12.4% obese. Men were significantly more likely overweight than women, and persons 50 years and older were more likely to be overweight and obese than younger adults (see Table 1).

### Behavioural risk factors and overweight and obesity

In terms of behavioural risk factors, 6.8% reported to drink 4 or more alcoholic drinks on the same day several times a week or daily, 52.7% ate FV daily, 15.5% engaged daily in physical activity for at least 20 min (making you sweat or breath more heavily than usual), 31.7% were overweight and 12.4% obese, according to BMI classification (see Table 2).

### Associations with overweight and obesity

Multivariate logistic regression, adjusted for age, sex, education, subjective economic status, residential status, psychological well-being, chronic condition and activity limitation, found that overall, among men and among women ex-smoking was associated with both overweight and obesity, while light or moderate smoking overall and among men was inversely related and heavy smoking overall, among men and women was not associated with obesity. Regarding alcohol use, overall, drinking 4 or more drinks in a day once a month or less or several times a month were associated with both overweight and obesity, while several times a week or daily drinking of 4 or more drinks in a day was inversely associated with overweight. Among men, low drinking frequency (drinking 4 or more drinks in a day once a month or less or several times a month) was correlated with overweight, while higher drinking frequency (drinking 4 or more drinks in a day several times a week or daily) was negatively associated with overweight. Further, medium drinking frequency (drinking 4 or more drinks in a day several times a month) was associated with obesity. Among women, drinking 4 or more drinks once a month or less was associated with obesity.

In terms of consumption of FV, eating them daily was found to be protective from both overweight and obesity overall and for men but not for women. Further, overall and for men any frequency of physical activity for at least 20 min (from once a month or several times a month to daily) was associated with overweight, while for women once a month or several times a month or several times a week physical activity was associated with overweight (see Tables 3 and 4).

## Discussion

In logistic regression models, after adjusting for sociodemographics, health variables and behaviour risk factors, the study found that ex-smokers and, low FV consumption were associated with overweight and obesity. This finding concurs with previous studies [4,5,13].

In a systematic review of prospective cohort studies, Tian et al. [22] found that ''compared with continuing smoking, quitting smoking was significantly associated with absolute weight and BMI gain.'' The intake of nicotine seems to be associated with satiety, and nicotine withdrawal with hunger and increased food consumption [23]. It is possible that when the addiction of smoking is terminated, it is substituted by another addiction (obesity). In this case the rewarding effects of the food substitute for the rewarding effects of smoking [24,25]. According to Volkow et al. [26] ''Increased intake of foods high in fat and sugar activates reward circuitries in the brain similar to those activated by smoking.'' More programs are needed to prevent weight gain after smoking cessation. In the

**Table 1** Sample, socio-demographic and confounding factors.

| Variables | Sample N (%) | Overweight % (95% CI) | Obese % (95% CI) |
|---|---|---|---|
| Sociodemographic variables | | | |
| Sex | | | |
| Female | 25016 (51.6) | 25.5 (25.0–26.1) | 12.5 (12.1–13.0) |
| Male | 23508 (48.4) | 38.2 (37.5–39.0) | 12.1 (11.7–12.6) |
| Age in years | | | |
| 15–30 | 10134 (20.9) | 18.9 (18.1–19.7) | 5.6 (5.1–6.1) |
| 31–50 | 18089 (37.3) | 31.4 (30.7–32.1) | 11.7 (11.2–12.1) |
| >50 | 20229 (41.8) | 38.1 (37.5–38.8) | 16.2 (15.8–16.7) |
| Residential status | | | |
| Rural | 16568 (34.2) | 32.4 (31.7–33.1) | 13.3 (12.8–13.8) |
| Urban | 31828 (65.8) | 32.1 (31.6–32.6) | 12.3 (12.0–12.7) |
| Educational status | | | |
| ≤Primary | 7024 (14.6) | 31.6 (30.5–32.6) | 14.3 (13.5–15.2) |
| Secondary | 22755 (47.2) | 33.1 (32.5–33.7) | 13.3 (12.8–13.7) |
| Post-secondary | 18424 (38.2) | 31.3 (30.7–32.0) | 11.2 (10.8–-11.7) |
| Subjective socioeconomic status | | | |
| Lowest | 12880 (29.5) | 30.4 (29.6–31.2) | 13.2 (12.6–13.8) |
| Low | 11828 (27.0) | 32.0 (31.2–32.9) | 12.5 (11.9–13.1) |
| High | 8637 (19.7) | 33.1 (32.1–34.1) | 11.8 (11.1–12.5) |
| Highest | 10389 (23.8) | 33.2 (32.3–34.1) | 10.0 (9.5–10.6) |
| Health variables | | | |
| Perceived health status | | | |
| Poor/fair | 13813 (29.2) | 32.5 (31.7–33.4) | 19.2 (18.5–19.9) |
| Good | 18241 (38.6) | 34.6 (33.8–35.4) | 12.2 (11.7–12.8) |
| Very good/excellent | 15202 (32.2) | 27.6 (26.8–28.4) | 6.7 (6.3–7.2) |
| Unhappy and depressed | | | |
| Never | 17039 (37.2) | 33.6 (32.8–34.4) | 11.2 (10.7–11.8) |
| Seldom | 12740 (27.8) | 31.2 (30.3–32.2) | 11.2 (10.6–11.8) |
| Sometimes | 11312 (24.7) | 29.3 (28.4–30.3) | 13.2 (12.5–13.9) |
| Often/very often | 4711 (10.3) | 30.8 (29.4–32.3) | 18.5 (17.3–19.7) |
| Chronic condition/disability | | | |
| Yes | 14942 (31.1) | 34.8 (33.9–35.7) | 19.0 (18.4–19.7) |
| No | 33118 (68.9) | 30.4 (29.8–30.9) | 9.4 (9.1–9.8) |
| Activity limitation | | | |
| Never | 20465 (45.8) | 32.3 (31.6–32.9) | 10.6 (10.2–11.1) |
| Seldom | 10190 (22.8) | 31.4 (30.5–32.3) | 11.1 (10.5–11.8) |
| Sometimes | 8593 (19.2) | 33.8 (32.8–34.7) | 14.8 (14.1–15.6) |
| Often or very often | 5437 (12.2) | 31.9 (30.7–33.2) | 20.8 (19.7–21.9) |

overall study sample, and among men in particular, light or moderate smoking was inversely related with obesity. Similarly, previous studies found an inverse relationship between body mass index (BMI) and smoking [6–8,12,14,16]. It is possible that the light to moderate smoking among men was paired with other factors such as the consumption of more food due to the appetite stimulation from smoking [24–26]. While this study did not find such an association with overweight light or moderate smokers, but only with obese light or moderate smokers, the relationship becomes problematic among obese smokers [6]. Further, the importance of FV consumption should be highlighted not only for the protection from non-communicable chronic conditions such as cardiovascular diseases [27] but also for maintaining or even lowering body weight and probably the prevention of obesity [28].

Further, the study found a positive association between moderate alcohol use and overweight and obesity, and a negative association between heavy alcohol use and overweight. This result is contrary

**Table 2** Behavioural risk factors.

| Variables | All N (%) | Over-weight % | Obese % | Over-weight = men % | Over-weight = women % | Obese-men % | Obese-women % |
|---|---|---|---|---|---|---|---|
| Smoking cigarettes | | | | | | | |
| Never | 24221 (51.4) | 29.1 | 12.0 | 37.0 | 24.7 | 11.6 | 12.1 |
| Before | 19920 (23.2) | 38.3 | 16.3 | 44.0 | 29.5 | 16.3 | 16.2 |
| Light/moderate | 10783 (22.9) | 31.2 | 9.8 | 35.1 | 24.9 | 9.0 | 11.0 |
| Heavy | 1193 (2.5) | 33.8 | 13.7 | 35.6 | 26.3 | 12.9 | 15.2 |
| *Alcohol*—drink 4 or more alcoholic drinks/same day | | | | | | | |
| Never | 26315 (56.0) | 29.8 | 13.0 | 37.0 | 25.8 | 12.5 | 13.2 |
| Once a month or less | 11340 (24.1) | 33.9 | 12.2 | 40.3 | 25.4 | 12.1 | 12.3 |
| Several times a month | 6100 (13.0) | 35.3 | 12.1 | 40.1 | 23.7 | 13.3 | 9.6 |
| Several times a week or daily | 3236 (6.9) | 34.0 | 10.7 | 35.9 | 25.4 | 10.6 | 10.2 |
| *Diet*—eat fresh fruit or vegetables | | | | | | | |
| Never/once a month or less/several times a month | 6840 (14.2) | 32.2 | 13.8 | 37.7 | 24.5 | 13.5 | 14.2 |
| Several times a week | 15016 (31.2) | 33.4 | 13.0 | 39.5 | 26.4 | 12.9 | 13.1 |
| Daily | 26299 (54.6) | 30.7 | 11.6 | 37.7 | 25.3 | 11.1 | 11.8 |
| *Physical activity*—for at least 20 min | | | | | | | |
| Never | 11773 (24.7) | 28.9 | 13.8 | 33.6 | 25.8 | 12.6 | 14.5 |
| Once a month/several times a month | 15.857 (33.8) | 33.0 | 12.6 | 40.1 | 25.4 | 13.1 | 12.1 |
| Several times a week | 12322 (25.9) | 32.5 | 10.9 | 40.6 | 23.7 | 11.3 | 10.5 |
| Daily | 7668 (16.1) | 32.2 | 11.6 | 38.1 | 25.4 | 10.6 | 12.4 |
| All | | 31.7 | 12.5 | 38.2 | 25.2 | 12.1 | 12.2 |

**Table 3** Adjusted[a] odds ratios for overweight among adults, overall, for men and women in 31 countries, 2011–2013.

| Variable | Overall, AOR (95% CI) | Men, AOR (95% CI) | Women, AOR (95% CI) |
|---|---|---|---|
| Smoking cigarettes | | | |
| Never | 1 (Reference) | 1 (Reference) | 1 (Reference) |
| Before | 1.12 (1.05–1.19)*** | 1.12 (1.03–1.23)** | 1.25 (1.14–1.37)*** |
| Light/moderate | 0.88 (0.92–1.05) | 0.97 (0.88–1.07) | 1.09 (0.98–1.20) |
| Heavy | 0.95 (0.79–1.15) | 0.99 (0.82–1.22) | 1.06 (0.75–1.51) |
| *Alcohol*—drink 4 or more alcoholic drinks on the same day | | | |
| Never | 1 (Reference) | 1 (Reference) | 1 (Reference) |
| Once a month or less | 1.09 (1.02–1.16)* | 1.10 (1.00–1.19)* | 1.09 (0.99–1.20) |
| Several times a month | 1.13 (1.04–1.22)** | 1.16 (1.05–1.28)** | 0.99 (0.86–1.16) |
| Several times a week or daily | 0.80 (0.72–0.90)*** | 0.81 (0.71–0.93)** | 0.86 (0.65–1.09) |
| *Diet*—eat fresh fruit or vegetables | | | |
| Never/once a month or less/several times a month | 1 (Reference) | 1 (Reference) | 1 (Reference) |
| Several times a week | 1.03 (0.95–1.12) | 1.00 (0.90–1.11) | 1.06 (0.94–1.20) |
| Daily | 0.90 (0.83–0.97)** | 0.88 (0.79–0.97)* | 0.98 (0.87–1.10) |
| *Physical activity*—for at least 20 min | | | |
| Never | 1 (Reference) | 1 (Reference) | 1 (Reference) |
| Once a month/several times a month | 1.27 (1.18–1.30)*** | 1.33 (1.20–1.47)*** | 1.22 (1.11–1.34)*** |
| Several times a week | 1.23 (1.15–1.33)*** | 1.34 (1.21–1.49)*** | 1.12 (1.01–1.26)* |
| Daily | 1.19 (1.09–1.29)*** | 1.33 (1.18–1.49)*** | 1.03 (0.91–1.15) |

[a] Adjusted for age, sex, education, subjective SES, residential status, subjective health status, unhappy or depression, chronic condition and activity limitation.

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.

to some previous studies that found that light-to-moderate alcohol intake was protective and higher levels of drinking were associated with weight gain [9,10,12]. Yet, our study assessed binge or heavy drinking (consuming four or more drinks per day), which also in a previous study increased the odds of overweight and obesity among binge drinkers and/or heavy drinkers compared to those who consumed the same amount of alcohol over multiple sessions [29]. Among adults who drink, alcohol accounts for nearly 10% of the calorie intake, indicating a significant increase in daily energy intake when alcohol is consumed [30,31]. Further research may help to clarify the complex relationship between alcohol use and obesity, in particular, in the context of broader lifestyle behaviours [32].

Physical inactivity was in this study inversely associated with overweight, but not associated with obesity, as found in a few previous studies [3]. Some previous studies [3] found a curvilinear relationship of moderate-to-vigorous physical activity with BMI [3]. For weight maintenance or weight reduction considerably larger amounts of physical activity than those for general health promotion are required [33]. It is possible that the cut-offs for physical activity measured in this study do not reflect these higher requirements of physical activity. In addition, apart from physical activity, body weight and BMI are determined by multiple other factors [33]. Physical activity contributes to energy expenditure and is recommended for preventing obesity, aiding in weight loss, and decreasing rates of chronic diseases [34].

## Study limitations

This study had several limitations. Firstly, this analysis was limited to the 31 countries that participated in the ISSP health and health care module survey [19], which did not include countries from Africa (as the only country South Africa the BMI was not assessed and therefore excluded) and Arab countries. Secondly, the questionnaire assessed only limited aspects of behavioural risk behaviours such as physical activity and diet, and more comprehensive and standardised assessment measures, such as the Global Physical Activity Questionnaire,

**Table 4** Adjusted[a] odds ratios for obesity among adults, overall, for men and women in 31 countries, 2011—2013.

| Variable | Overall, AOR (95% CI) | Men, AOR (95% CI) | Women, AOR (95% CI) |
|---|---|---|---|
| Smoking cigarettes | | | |
| Never | 1 (Reference) | 1 (Reference) | 1 (Reference) |
| Before | 1.30 (1.19—1.42)*** | 1.25 (1.10—1.42)*** | 1.43 (1.26—1.63)*** |
| Light/moderate | 0.80 (0.72—0.88)*** | 0.71 (0.61—0.82)*** | 0.94 (0.82—1.09) |
| Heavy | 0.93 (0.72—1.20) | 0.88 (0.65—1.18) | 1.16 (0.73—1.81) |
| *Alcohol*—drink 4 or more alcoholic drinks on the same day | | | |
| Never | 1 (Reference) | 1 (Reference) | 1 (Reference) |
| Once a month or less | 1.10 (1.01—1.20)* | 1.08 (0.94—1.23) | 1.13 (1.00—1.27)* |
| Several times a month | 1.15 (1.02—1.30)* | 1.21 (1.04—1.41)* | 0.96 (0.70—1.28) |
| Several times a week or daily | 0.85 (0.73—1.00) | 0.90 (0.75—1.09) | 0.74 (0.52—1.05) |
| *Diet*—eat fresh fruit or vegetables | | | |
| Never/once a month or less/several times a month | 1 (Reference) | 1 (Reference) | 1 (Reference) |
| Several times a week | 1.02 (0.91—1.14) | 0.99 (0.84—1.16) | 1.06 (0.90—1.25) |
| Daily | 0.88 (0.79—0.98)* | 0.83 (0.71—0.97)* | 0.97 (0.83—1.13) |
| *Physical activity*—for at least 20 min | | | |
| Never | 1 (Reference) | 1 (Reference) | 1 (Reference) |
| Once a month/several times a month | 1.05 (0.96—1.15) | 1.12 (0.97—1.30) | 0.98 (0.87—1.11) |
| Several times a week | 0.99 (0.89—1.10) | 1.05 (0.89—1.23) | 0.92 (0.80—1.06) |
| Daily | 0.90 (0.80—1.00) | 0.89 (0.75—1.06) | 0.90 (0.77—1.05) |

[a] Adjusted for age, sex, education, subjective SES, residential status, subjective health status, unhappy or depression, chronic condition and activity limitation.
* $P < 0.05$.
*** $P < 0.001$.

standard serving sizes for FV intake and the type of alcoholic beverages, including wine, consumed and should be included in future surveys. Furthermore, this study was based on data collected in a cross sectional survey so that no causative conclusions can be drawn.

## Conclusion

A high prevalence overweight and obesity was found in 20 countries in Europe, 8 countries in Asia, Australia, Chile and USA. Several common behavioural risk factors were identified which may be targeted to reduce the risk of overweight and obesity.

## Conflict of interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

## References

[1] Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980—2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2014;384(9945):766—81.
[2] Serra-Majem L, Bautista-Castaño I. Etiology of obesity: two key issues and other emerging factors. Nutr Hosp 2013;28(Suppl. 5):32—43.
[3] Van Dyck D, Cerin E, De Bourdeaudhuij I, Hinckson E, Reis RS, Davey R, et al. International study of objectively measured physical activity andsedentary time with body mass index and obesity IPEN adult study. Int J Obes 2015;39(2):199—207.
[4] Ledoux TA, Hingle MD, Baranowski T. Relationship of fruit and vegetable intake with + adiposity: a systematic review. Obes Rev 2011;12(5):e143—50.
[5] Schwingshackl L, Hoffmann G, Kalle-Uhlmann T, Arregui M, Buijsse B, Boeing H. Fruit and vegetable consumption and changes in anthropometric variables in adult populations: a systematic review and meta-analysis of prospective cohort studies. PLoS One 2015;10(10):e0140846.
[6] Rupprecht LE, Donny EC, Sved AF. Obese smokers as a potential subpopulation of risk in tobacco reduction policy. Yale J Biol Med 2015;88(3):289—94.
[7] Dare S, Mackay DF, Pell JP. Relationship between smoking and obesity: a cross-sectional study of 499,504 middle-aged adults in the UK general population. PLoS One 2015;10(4):e0123579.
[8] Chiolero A, Jacot-Sadowski I, Faeh D, Paccaud F, Cornuz J. Association of cigarettes smoked daily with obesity in a general adult population. Obesity 2007;15(5):1311—8.
[9] Sayon-Orea C, Martinez-Gonzalez MA, Bes-Rastrollo M. Alcohol consumption and body weight: a systematic review. Nutr Rev 2011;69(8):419—31.

[10] Yeomans MR. Alcohol, appetite and energy balance: is alcohol intake a risk factor forobesity? Physiol Behav 2010;100(1):82—9.
[11] Peixoto Mdo R, Benício MH, Jardim PC. The relationship between body mass index and lifestyle in a Brazilian adult population: a cross-sectional survey. Cad Saude Publ 2007;23(11):2694—740.
[12] Hou X, Jia W, Bao Y, Lu H, Jiang S, Zuo Y, et al. Risk factors for overweight and obesity, and changes in body mass index of Chinese adults in Shanghai. BMC Public Health 2008;8:389.
[13] Lahti-Koski M, Pietinen P, Heliövaara M, Vartiainen E. Associations of body mass index and obesity with physical activity, food choices, alcohol intake, and smoking in the 1982—1997 FINRISK studies. Am J Clin Nutr 2002;75(5):809—17.
[14] Santos R, Aires L, Santos P, Ribeiro JC, Mota J. Prevalence of overweight and obesity in a Portuguese sample of adults: results from the Azorean Physical Activity and Health Study. Am J Hum Biol 2008;20(1):78—85.
[15] Erem C, Arslan C, Hacihasanoglu A, Deger O, Topbas M, Ukinc K, et al. Prevalence of obesity and associated risk factors in a Turkish population (Trabzon city, Turkey). Obes Res 2004;12(7):1117—27.
[16] Kruger J, Ham SA, Prohaska TR. Behavioral risk factors associated with overweight and obesity among older adults: the 2005 National Health Interview Survey. Prev Chronic Dis 2009;6(1):A14.
[17] Tian X, Zhao G, Li Y, Wang L, Shi Y. Overweight and obesity difference of Chinese population between different urbanization levels. J Rural Health 2014;30(1):101—12.
[18] Ul-Haq Z, Mackay DF, Fenwick E, Pell JP. Association between body mass index and mental health among Scottish adult population: a cross-sectional study of 37,272 participants. Psychol Med 2014;44(10):2231—40.
[19] ISSP Research Group. International Social Survey Programme: Health and Health Care—ISSP 2011. GESIS Data Archive, Cologne, 2015. ZA5800 Data file Version 3.0.0, doi: 10.4232/1.12252.
[20] International Social Survey Programme. Ethical statement. 2016. Available at: http://www.issp.org/uploads/editor_uploads/files/ethical_statement_issp.pdf [accessed 10.06.16.
[21] WHO. The International classification of adult underweight, overweight and obesity according to BMI. Available online: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html [accessed 15.06.14].
[22] Tian J, Venn A, Otahal P, Gall S. The association between quitting smoking and weight gain: a systemic review and meta-analysis of prospective cohort studies. Obes Rev 2015;16(10):883—901.
[23] John U, Meyer C, Rumpf HJ, Hapke U, Schumann A. Predictors of increased body mass index following cessation of smoking. Am J Addict 2006;15(2):192—7.
[24] Spring B, Pagoto S, McChargue D, Hedeker D, Werth J. Altered reward value of carbohydrate snacks for female smokers withdrawn from nicotine. Pharmacol Biochem Behav 2003;76:351—60.
[25] Lerman C, Berrettini W, Pinto A, Patterson F, Crystal-Mansour S, Wileyto EP, et al. Changes in food reward following smoking cessation: a pharmacogenetic investigation. Psychopharmacology 2004;174:571—7.
[26] Volkow ND, Wang GJ, Fowler JS, Telang F. Overlapping neuronal circuits in addiction and obesity: evidence of systems pathology. Philos Trans R Soc Lond B: Biol Sci 2008;363:3191—200.
[27] Alissa EM, Ferns GA. Dietary fruits and vegetables and cardiovascular diseases risk. Crit Rev Food Sci Nutr 2015;20(July).
[28] Slavin JL, Lloyd B. Health benefits of fruits and vegetables. Adv Nutr 2012;3(4):506—16.
[29] Arif AA, Rohrer JE. Patterns of alcohol drinking and its association with obesity: data from the Third National Health and Nutrition Examination Survey, 1988—1994. BMC Public Health 2005;5:126.
[30] Bates B, Lennox Alison, Swan G. National diet and nutrition survey: headline results from year 1 of the rolling programme (2008/2009). London: Food Standards Agency; 2009.
[31] Dennis EA, Flack KD, Davy BM. Beverage consumption and adult weight management: a review. Eat Behav 2009;10(4):237—46.
[32] National Obesity Observatory Obesity and alcohol: an overview February 2012. Available online: http://www.noo.org.uk/uploads/doc/vid_14627_Obesity_and_alcohol.pdf.
[33] Saris WH, Blair SN, van Baak MA, Eaton SB, Davies PS, Di Pietro L, et al. How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement. Obes Rev 2003;4(2):101—14.
[34] Waleh MQ. Impacts of physical activity on the obese. Prim Care 2016;43(1):97—107.